



FEDERATION OF NIGERIA

ANNUAL REPORT
ON THE
Department of Agricultural
Research

FOR THE YEAR 1955-56

NINEPENCE NETT

1957

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FOREWORD

In 1955 the Federal Government published a White Paper on Natural Resources which outlined the Government's policy on research development and undertook to establish a Council of Natural Resources of Nigeria for the purpose of co-ordinating various programmes of research throughout Nigeria. It is of special interest to note from this report on the work of the Department of Agriculture that the co-ordination promised by the formation of the new Council has already materialised and that co-operation with Regional Departments of Agriculture has been continued and strengthened. The most striking example of this co-operation is found in that part of the report which deals with the control of capsid pests of the cocoa trees. The fact that the Western Region Department of Agriculture has been exploiting to the full the results of invaluable research investigations is most satisfactory and encouraging. This case of co-operation also provides an example of how the cocoa farmer himself can benefit directly from the investigations of research workers.

2. Also of special interest to farmers is the report of the discovery of varieties of cassava and maize which have a potential yield which is more than double those at present being cultivated. It may be some time, however, before these varieties can be released to the farmers.

3. Once again the Director has found it necessary to report that there is a shortage of staff, which has restricted research activities. I hope that it will not be long before young Nigerian research workers will become available to undertake the important work that awaits them.

KOLAWOLE BALOGUN,
Minister of Research and Information

STAFF LIST AS AT 31ST MARCH, 1956 (INCLUDING OFFICERS OF THE MAIZE RESEARCH SCHEME AND RICE RESEARCH SCHEME)

Director of Agricultural Research :

Dr. J. M. Waterson, PH.D. (Edin.), B.SC., A.I.C.T.A.
(Resumed duty 30-11-55)

Principal Research Officer :

C. A. Thorold, M.A. (Oxon.), A.I.C.T.A. (Resumed
duty 24-8-55) *Administration and Plant Patholo-
gist*

Senior Specialist Officers :

G. S. Cotterell, A.R.C.S. (Lond.), D.F.C., F.R.E.S. .. *Senior Entomologist*
2 vacancies

Specialist Officers

J. T. Davey, B.SC. (Bristol), A.I.C.T.A. (On second-
ment to French Sudan) *Entomologist*
J. L. Gregory, B.SC. (Sheffield), D.A.S. (Cantab.),
D.T.A. (Trinidad) (Resumed duty 28-12-55) .. *Entomologist*
J. E. Y. Hardcastle, B.SC. (Dunelm), D.A. (Cantab.),
D.T.A. (Trinidad) (Resumed duty 24-3-55) .. *Botanist*
S. R. Chant, B.SC. (Edin.), D.A.S. (Cantab.), D.T.A.
(Trinidad) *Plant Pathologist*
B. D. A. Beck, B.SC. (Manch.), D.A.S. (Cantab.), D.T.A.
(Trinidad) *Botanist*
W. D. Clayton, B.SC. (Lond.), A.R.C.S. *Ecologist*
K. M. Harris, B.SC. (Wales), D.A.S. (Cantab.), D.T.A.
(Trinidad) (Assumed duty 7-9-55) *Entomologist*
J. A. R. Bates, B.SC. (Wales), A.R.I.C. (Assumed duty
24-8-55) *Chemist*
2 vacancies

MAIZE RESEARCH SCHEME

Chief Research Officer :

Vacant

Senior Scientific Officer :

Dr W. R. Stanton, B.SC. (Reading), PH.D. (Lond.) .. *Geneticist*

Scientific Officer :

R. H. Cammack, B.SC. (St Andrews) *Mycologist*

RICE RESEARCH SCHEME

Senior Agricultural Officer :

J. O. Goss, B.SC. Agric. (Lond.) *Temp. Agric. Officer*

Specialist Officer :

G. Jenkins, B.SC., D.T.A. (Trinidad) (Assumed duty
24-8-55) *Botanist*

Visiting Specialist

Dr. V. F. Eastop, PH.D. (Arrived 21-3-56) *Taxonomic Entomologist*

Superintendents, etc.

A. O. Bamtefa *Agric. Superintendent*
F. O. Iwenjora *Laboratory Superintendent*
D. A. O. Durosaro *Laboratory Superintendent*

Administrative Assistant :

M. I. Ntephe *Administrative Assistant, Grade II*

Annual Report of the Department of Agricultural Research (Federation of Nigeria) for the year 1955-56

REPORT OF THE DIRECTOR

INTRODUCTION

The limiting factor to the progress of Federal Agricultural Research during the period under review was, as in previous years, the shortage of scientific staff, particularly in the senior grades. As a result the Department reached only 60 per cent of the authorised establishment. Most of the present staff have only two to three years experience in the service and it is a tribute to their keenness and ability that steady progress continues to be made with the research programme. The main lines of investigation which followed those of the previous year included the improvement of food crops and the control of diseases and pests. Details will be found under the appropriate sectional headings which follow this report.

POLICY

Scientific research is included in the concurrent legislative list under the Nigeria (Constitution) Order in Council, 1954 and consequently it is open to any Government in Nigeria to engage in whatever research it wishes to undertake. It was recognised however that both funds and scientific personnel are limited and that there was a need for co-ordination of programmes of research to the mutual advantage of all Governments.

A White Paper on Natural Resources was approved at the August Meeting of the House of Representatives in 1955 which included proposals for the co-ordination of Agricultural Research in Nigeria. This Paper recognised the impossibility of attempting to draw any hard and fast distinction between research which can be most conveniently carried out by Regional Governments, and that which should fall to the Federal Department of Agricultural Research but it considered in general that fundamental or long-term research should be the concern of the Federal Government while the Regions should concern themselves primarily with short-term or applied research.

The formulation of a co-ordinated agricultural research programme is undertaken by a Technical Committee composed of the Director of Agricultural Research as Chairman, and the Directors of Agriculture of the Northern, Eastern and Western Regions, the Principal Agricultural Officer, Southern Cameroons and a representative of the Faculty of Agriculture of the University College, Ibadan. The main lines of investigation recommended for the Federal Department of Agricultural Research by this Committee for the next five years have been embodied in the Economic Programme 1955-60*. They endorse most of the recommendations made by the International Bank Mission which visited Nigeria in 1953 and include fundamental studies of soils and crop nutrition, the improvement of food crops with special reference to rice and research into measures for the control of plant diseases and pests.

Other functions of the Department of Agricultural Research which have been approved in the White Paper include the collection and dissemination of research both within Nigeria and from elsewhere ; and a plant importation and plant quarantine service.

The senior staff required for this expansion of Federal research activities will amount to 47 specialists and 14 technicians and will be roughly double the size of the present establishment.

* The Economic Programme of the Government of the Federation of Nigeria, 1955-60, Sessional Paper No. 2 of 1956.

A sum of £694,000 has been earmarked in the Economic Programme for Capital Development for the Department of Agricultural Research. Most of this will be used to expand existing facilities for the headquarters of Federal Agricultural Research at Moor Plantation, Ibadan and at the Federal Rice Research Station at Badeggi. The existing facilities at Moor Plantation are limited at the present time and are being shared with the Western Region Department of Agriculture. Negotiations are at present being conducted with the Western Region Government with a view to the transfer of Regional activities to a new site which would make available the additional land required for the expansion of Federal research activities.

STAFF

The Department lost one senior specialist on transfer to the Western Region but was strengthened by the arrival of three new specialist officers. Of a specialist establishment of 24, a total of 15 were filled. One Entomologist was attached to the Northern Region Agricultural Research Station at Samaru, two Botanists and an Agricultural Officer were stationed at the Federal Rice Breeding Station at Badeggi and one Entomologist was on secondment in the French Soudan.

The authorised establishment of senior staff at the beginning of the year and the actual strength at 31st March, 1956, are given in the following table :—

	Authorised	Actual
<i>Pensionable Establishment</i>		
Director of Agricultural Research.. ..	1	1
Principal Research Officer	1	1
Senior Specialist Officers	3	1
Specialist Officers	10	8
Temporary Technical Publications Officer	1	—
Agricultural Superintendent	1	1
Laboratory Superintendents	2	2
Secretary-Typist	1	—
<i>Development Schemes No. D2240—Agriculture</i>		
Administrative Assistant, Grade II	1	1
<i>No. R471 and R471A—Maize Rust Research</i>		
Chief Research Officer	1	—
Senior Scientific Officer	1	1
Scientific Officer	1	1
<i>No. R514—Rice Research</i>		
Specialist Officer	1	1
Agricultural Officer	1	1
<i>No. R565—Fungicides Research*</i>		
Senior Scientific Officer	1	—
Scientific Officers	2	—
Inspector of Works (Mechanical)	1	—
	<u>30</u>	<u>19</u>

* It is now proposed to transfer this scheme to East Africa in view of the difficulty of staff recruitment.

The corresponding position for junior staff at March 1956 showed a total number of 30 vacancies in an establishment of 172 and was as follows :—

	<i>Authorised</i>	<i>Actual</i>
Chief Clerk	1	1
Assistant Chief Clerk	1	1
First-class Clerks	7	5
Second and Third-class Clerks	19	18
Clerical Assistants	7	7
Telephone Attendants	3	3
Messengers	10	8
Assistant Agricultural Officers, Grade I	4	2
Assistant Agricultural Officers, Grades II and III	6	—
Senior Agricultural Assistants	5	5
Agricultural Assistants, Grade I	4	4
Agricultural Assistants, Grades II and III	33	31
Field Overseers, Grades I and II	43	43
Artisans	2	2
Laboratory Attendants	6	3
Driver Mechanics	3	2
Temporary Field Staff	7	7
Temporary Clerical Staff	1	—
	172	142

PROGRESS OF RESEARCH WORK

Investigation on Soil Fertility.—The arrival of a Chemist enabled a start to be made on fundamental studies. Up until now the traditional method of maintaining soil fertility in Nigeria has been through the use of “bush” fallows, usually by allowing the land to rest by its return to some form of forest cover for a period of several years after two or more seasons of continuous cropping. During the last twenty-five years however there has been a marked rise in the population of the country which in turn has led to an increased pressure on the land for the production of foodstuffs. In order that this growing population may be able to enjoy a rising standard of living it will be essential to expand agricultural production and to improve the methods of management and development of our natural resources. The net result will be the tendency for this type of fallow to disappear from our farms, and an important problem will be to determine whether crop yields can be maintained in the absence of a fallow, or in a shortened fallow period with frequent applications of small quantities of fertilizers. The basic scientific problem is firstly to discover why the traditional forest fallow improves the fertility of the soil, and secondly, to find means of bringing about this improvement much more quickly than the forest does. The Chemist has made a start on this problem and is concentrating his studies on soil organic matter with special reference to the formation of humus.

The Ecologist carried out several useful surveys at Shendam, Badeggi, Edozhigi and Hadejia and obtained close correlation of vegetation with soil types.

Improvement of Food Crops.—The main efforts of the Federal Department of Agricultural Research have been devoted to the improvement of food crops, particularly with respect to cassava and yams which provide the bulk of the carbohydrate food of Nigeria. Practically all the cassava plants in Nigeria are infected with virus, causing the widespread mosaic disease which is regarded as of major importance in the research programme. This virus disease has been successfully transmitted to healthy seedlings through the white fly vector (*Bemisia* spp.), and also by grafting. Now that techniques for production and germination of cassava seed have been satisfactorily developed, tests for possible resistance can proceed.

In addition to the work on cassava, research on maize and rice improvement was carried out under two Colonial Development and Welfare Schemes.

Varieties of cassava and maize are now available which have a potential yield double those at present cultivated by the farmer. Further selection work is required however for disease and pest resistance, as well as for palatability, before these can be released.

The provision of superior types of high yielding food crops by the plant breeders will help to meet the heavier demand on the land which the increasing population of Nigeria will make. The problem however is not simply to produce two blades of grass where one grew before. There is particular need for health protective foods as well, of high nutritive value. These can only be obtained by diversifying our present agricultural systems with the introduction of a better variety of crops to ensure an adequate and nutritionally satisfactory food supply.

Towards this end, a collection of useful plants is maintained in an Economic Garden at Moor Plantation which includes important new introductions to provide material for distribution to Regions. It is planned to develop these investigations as soon as a Horticulturist can be secured.

Control of Plant Diseases and Pests.—The progress made in controlling black-pod disease of cocoa, caused by *Phytophthora palmivora*, in the Western Region of Nigeria has been remarkable. It was only six years ago that a Plant Pathologist was appointed to study the problem and only two years ago that general spraying of cocoa began. Yet this year it is estimated that the number of cocoa farmers using fungicidal sprays will have risen to well over 25,000. It has been estimated that the amount of cocoa saved from destruction by this disease may well have exceeded 7,000 tons in a single Province and that this alone is likely to be more than sufficient to pay for the cost of all imported chemicals and equipment.

A notable contribution to the success of these control measures has been the very close collaboration between the Federal Department of Agricultural Research which carried out the original investigations and the Regional Departments of Agriculture and the Co-operative Movement who together worked out the details of applying the results of this research including the training of farmers in the use of the new methods.

Mention must also be made of the assistance given by manufacturers of spray materials and equipment who made special efforts to cope with the heavy demands for large scale supplies, as well as providing technical advice. Lastly but not least, tribute should be paid to the Nigerian farmer for his readiness to try new techniques.

One result from this successful attack on the cocoa black-pod problem has been the encouragement given to further investigations on the control of cocoa pests, notably capsids. Joint investigations at present being carried out with the West African Cocoa Research Institute indicate promising measures of control using gamma BHC. Yields and quality of yams (*Dioscorea* spp.) are seriously affected in some areas by the yam beetle (*Heteroligus* spp.). It is now known that damage caused by this pest can be considerably reduced by treatment of 'seed' yams with BHC dust before planting, but adequate monetary returns could not be demonstrated in all experiments. Further experiments are proceeding with the purpose of developing economic control of yam beetle.

A start has been made by the Plant Pathologist on the study of cassava mosaic and an attempt is being made to assess high yielding clones that are tolerant to the disease. More basic research on the disease and its relation to the insect vector *Bemisia* spp. is planned.

In this connexion the Senior Entomologist has carried out a survey of host plants of Aleyrodidae in the Ibadan area with particular reference to *Bemisia* species which are vectors of cassava mosaic and leaf curl diseases of cotton and tobacco. The survey is being continued by Dr. V. F. Eastop, a Taxonomist from the British Museum of Natural History who is visiting West Africa under C.D. & W. (R) Scheme No. 725 to study aphids and whiteflies.

INTER-TERRITORIAL RESEARCH INSTITUTES

Meetings of the Management and Technical Committees were regularly attended throughout the year and the research needs of all Regions kept in view. In common with other research organisations staff shortages are the limiting factor to the extent of the research programme, nevertheless steady progress was made.

COLONIAL DEVELOPMENT AND WELFARE SCHEMES

West African Maize Research Scheme.—The work of breeding and selection has continued along the same lines as in previous years. Yield trials were carried out with a number of top-cross hybrids to test the combining ability of the inbred lines used. The yield of inbred lines selected from the Caribbean area was also tested. Studies of the inheritance of rust resistance were continued in the laboratory. No evidence of linkage with marker genes has been obtained to date.

Nigerian Rice Research Scheme.—No progress was made with the building programme during the period under review owing to inadequacy of the funds originally allocated. Nevertheless good progress was made in clearing the experimental site and in the collection and classifying of rice varieties.

VISITING MISSIONS

The report of a Mission (Messrs C. R. Enlow and W. L. Dutton) organised by F.O.A. which undertook a preliminary survey of range and pasture resources in Nigeria during June-December 1954, has now come to hand. The recommendations which concern the Federal Government were those which drew attention to the need for hydrological surveys and ground-water studies to obtain information on which to base an extended programme of water development, the lack of which at present was regarded as a serious obstacle to proper utilization of dry season grazing lands; to the need for legislation for control of natural resources and a recommendation that a Grassland Division be established in the Federal Department of Agricultural Research if and when problems of national import become paramount.

The need for Hydrological surveys has already been stressed by the International Bank Mission and the matter is receiving the attention of Government whilst the remaining two recommendations are being kept in view by the Agricultural Technical Committee.

THE ROYAL VISIT TO MOOR PLANTATION

The Department was honoured by a visit from Her Majesty the Queen and His Royal Highness the Duke of Edinburgh on the 13th of February, 1956. Her Majesty inspected demonstrations staged in front of the Botanical Laboratory illustrating the Work of the specialist sections of the Federal Department of Agricultural Research and that of the West African Maize Research Unit and the West African Cocoa Research Institute. Her Majesty also inspected exhibits illustrating the research activities of the Western Region Department of Agriculture. Her Majesty and His Royal Highness then made a tour of Moor Plantation by car passing *en route* the long-term experiments in the maintenance of soil fertility, the experimental oil palm plots maintained by the West African Institute for Oil Palm Research and an exhibit of livestock prepared by the Western Region Department of Agriculture.

INTERCHANGE OF VISITS BY SPECIALISTS TO NEIGHBOURING TERRITORIES

Mr C. A. Thorold, Principal Research Officer, attended meetings and visits in the course of the Commonwealth Agricultural Bureaux Review Conference, held in the United Kingdom during June and July 1955. Mr J. L. Gregory, Entomologist, attended the Cocoa Conference, held in London from 13th to 15th September, 1955. Dr V. F. Eastop, Entomologist at the British Museum (Natural History) arrived in Nigeria on 21st March, 1956. He is temporarily attached to the Entomology Section for studies of West African Aphidae and Aleyrodidae.

Mr J. T. Davey, Entomologist, continued to serve on secondment as leader of a mission in the French Sudan, studying the African Migratory Locust. Mr G. S. Cotterell, Senior Entomologist, visited the Gold Coast in December 1955 to observe and discuss capsid control procedure. Mr W. D. Clayton, Ecologist, went on tour to the Gold Coast in October 1955 and visited the Faculty of Agriculture, University College, at Achimota, the Department of Soil and Land-Use Survey, at Kumasi, and the Grassland Ecologist, at Tamale.

Visiting Scientists from outside territories included Mr C. G. Eastwood, C.M.G., Deputy Under Secretary of State, Colonial Office; Sir William Slater, K.B.E., D.Sc., F.R.I.C., Secretary, Agricultural Research Council; Dr W. F. Jepson, Stored Products Pest Infestation Subcommittee, Colonial Office; Mr D. W. Hall, Senior Scientific Officer, Department of Scientific and Industrial Research, Pest Infestation Laboratory; Mr H. R. Mapother, Insecticides Chemist, West African Cocoa Research Institute; Mr N. Wright, Plant Protection Limited; Dr Anne Hewlett, Mr E. Nyenhuis and Dr B. J. Harris, University College of the Gold Coast; Shri Rama Rao Panje, Botanist, Sugarcane Breeding Institute, Coimbatore (to collect material of *Saccharium spontaneum* which he obtained in the Northern Region); Dr Robert L. Fowler, U. S. Foreign Operations Administration, and Mr Ireneo Chaves, Cacao Institute, Bahia; Professor C. T. Ingold, Birbeck College, University of London and Dr W. S. S. Ladell, Hot Climate Physiological Research Unit.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge our indebtedness to the Commonwealth Agricultural Bureaux, and to the Directors of the Research Stations at Rothamsted, East Malling and Long Ashton, for their continued assistance with many technical problems.

J. M. WATERSTON,
Director of Agricultural Research

30th November, 1956.

SECTIONAL REPORTS

CHEMISTRY

STAFF

J. A. R. BATES *Chemist*

The maintenance and improvement of soil fertility have been studied in the past at Moor Plantation by means of long-term experiments involving fallow and green manuring. Test-crops have been the principal means for assessing effects of rotational treatments although fertilizer applications have also been used to this end.

Mr Bates assumed duty in August 1956 and has reviewed the present experiments with the advice of Rothamsted Research Station. It has been agreed that the present experiments are unsatisfactory and that a new approach of a more fundamental nature is required with a view to understanding the processes involved in the building up of soil fertility under different types of cover. A special study is being undertaken in this connexion on the formation of humus.

BOTANY

STAFF

B. D. A. BECK *Botanist*
W. D. CLAYTON *Ecologist*
D. A. O. DUROSARO *Laboratory Superintendent*

In accordance with research allocations agreed at the Agricultural Technical Committee investigations on cocoa at Agodi, Owena and Odo Ona Nla were handed over to the Western Region Department of Agriculture. Consequently, more time and attention was available for investigations on food crops.

Weather conditions were again wetter than average, the increase being mainly due to heavy rain in September and October.

METEOROLOGICAL DATA FOR MOOR PLANTATION, IBADAN 1955

<i>Months</i>	<i>Rainfall</i>			<i>Mean RH % 0900 GMT</i>	<i>Temperature</i>		
	<i>Inches</i>	<i>(Days)</i>	<i>Average 1944-55 (inches)</i>		<i>Mean Max. °F 0900 GMT</i>	<i>Mean Min. °F 0900 GMT</i>	<i>Mean Temp. °F 0900 GMT</i>
January	1.39	(4)	0.23	85.3	90.0	67.8	78.9
February	0.53	(1)	1.11	80.9	93.6	71.6	82.7
March	4.06	(10)	2.49	81.9	92.1	69.7	80.9
April	6.41	(11)	5.77	80.9	90.1	69.5	79.8
May	6.87	(16)	6.17	81.4	89.5	68.8	79.1
June	6.90	(19)	7.02	85.8	86.6	68.7	77.7
July	3.59	(18)	5.58	87.9	80.2	68.2	74.2
August	2.97	(17)	3.26	87.1	82.3	67.7	75.0
September	10.22	(23)	7.49	88.0	83.0	68.3	75.7
October	10.71	(21)	7.78	86.7	85.8	68.2	77.0
November	2.40	(4)	2.20	83.4	91.0	69.0	80.0
December	0.02	(2)	0.24	79.9	89.8	66.9	78.4
Total	56.07	(146)	49.34	—	—	—	—
Mean	—	—	—	84.10	87.75	68.71	78.28

FOOD CROPS

Cassava.—B. D. A. Beck. The improvement of cassava is a joint project of the Botanist, Senior Entomologist and the Plant Pathologist. The objectives are to develop by selection and breeding varieties which are high yielding, more tolerant to cassava mosaic virus and with a low hydrogen cyanide content. Information is also being collected on the inheritance of variety characters and the classification of characters into linkage groups.

A comparison of yield of the eight most promising varieties from the 1954-55 collection plots showed the superiority of varieties Oloronto and NH 40. Yields in this trial were low even with fertilizer applications, the variety Oloronto producing only 9.7 tons per acre.

Preliminary investigations of the hydrogen cyanide content of cassava tubers indicate that this varies with the variety and increases with length of time of storage. The variety GCH7 contained a higher HCN content when grown in soil of the Iwo series than when grown in the sandier soils of the Apomu series. With high fertilizer applications the amount of HCN in the tubers grown on Apomu series soil is increased and approaches that of tubers produced in Iwo series soil.

Yam.—A collection of 57 Nigerian varieties belonging to the species *Dioscorea rotundata*, *D. alata*, *D. dumetorum*, *D. cayennensis* and *D. esculenta* was maintained at Moor Plantation in preparation of the arrival of a Plant Breeder who will work on the improvement of this crop.

The highest yielding varieties belonged to the *dumetorum* group. Flowering was observed within the *rotundata*, *dumetorum* and *cayennensis* groups. *Rotundata* and *dumetorum* set seed but none appeared to be viable.

Tomato.—A total of 68 tomato varieties were grown during both the wet and the dry seasons at Ibadan. Yields of all varieties were relatively small. The mean fruit weight per variety was greater in the wet season (7-157 gm.) than in the dry (17-89 gm.), although the mean total yield per plant was greater during the dry season (maximum 956 gm. per plant) as compared with the wet season (232 gm. per plant).

TREE CROPS

Kola.—A breeding programme was begun with the object of studying the possibility of selecting high-yielding trees and the factors associated with spasmodic bearing. Incidental studies are proceeding on the inheritance of cotyledon colour and on suspected incompatibility in kola trees.

ECOLOGICAL INVESTIGATIONS—W. D. CLAYTON

The early part of the year was devoted to a vegetation survey of Lowlands Experiment Farm, in the Lowlands Division of Plateau Province, about 18 miles south-east of Shendam. The Farm covers an area of about 3 square miles, and is associated with a Resettlement Scheme, designed to accommodate tribes migrating from the foothills of the Plateau into a region depopulated by slave raiding, and to establish them in a stable system of agriculture. The Farm lies in a region where the 'bush' has received relatively little cultivation, on the boundary of the southernmost extension of Sudan-zone vegetation. The soils of Lowlands Farm had already been surveyed by the Chemist, Northern Region. After a detailed vegetation survey had been made of the same area, it was possible to demonstrate a close correlation between vegetation and soil type, so that many of the properties of the soil could be inferred from the nature of the vegetation. The survey was subsequently extended by traverses along the motorable roads, coupled with aerial photograph interpretation, covering about 250 square miles of the neighbouring country. Since the general distribution of soil types could be deduced from the resulting vegetation map, this method provided a rapid means for the reconnaissance of an area undergoing development.

During September an ecological survey was made of the irrigation scheme at Badeggi, near Bida, Niger Province, on the edge of the Gbako River flood plain. It is also the site of the Federal Rice Breeding Station. The distribution of the vegetation types may be explained by variations in the soil moisture status. These are of two types, those due to local conditions of soil texture and drainage, and those imposed by the annual flooding of the river. The most suitable conditions for rice cultivation occur on a narrow strip of land at the edge of the flood plain, which bears a number of plant communities characterized by the grouping of the taller trees into clumps upon large termite mounds. Water is easily impounded upon this land during the rainy season by means of simple bunds and irrigation ditches. There is no risk of the rice being totally submerged for any length of time during its growing period, because this land is just above the normal flood level. The main flood plain, characterized by open grass land with *Mitragyna inermis*, is not at present used for rice cultivation. This seems to be largely because the local farmers plant their crops so late (July or August), that the young plants would suffer from the floods of September and October.

A brief examination was made of a neighbouring irrigation scheme at Edozhigi on the Kaduna River. Rice cultivation has been practised here for about 100 years, consequently, little of the original vegetation remains. It is apparent from a study of aerial photographs, that this very old-established tradition of rice cultivation has been established upon a belt of land at the edge of the flood plain, and which is speckled with the remains of old termite mounds. It is apparently analogous to the very much smaller area of suitable land at Badeggi.

In December, an ecological survey was made of part of the Hadejia River flood plain, near the town of Hadejia. The grade of the river is very slight, and it is subject to frequent and large-scale changes of course, so that it occupies a wide flood plain marked with innumerable oxbow lakes and old meander scars. Scattered in the flood plain are the partially dissected remains of seif dunes, formed during an earlier period of desert conditions. Most of the better drained soils are heavily cultivated, and only a low scrub growth is able to develop during the short fallows. A large part of the flood plain is occupied by swamps, where the vegetation shows a close correlation with soil type. Much of the swamp land should be suitable for rice cultivation, though the behaviour of the floods requires further study.

RICE RESEARCH SCHEME R514

STAFF

J. E. Y. HARDCASTLE	..	..	..	<i>Botanist-in-charge</i>
G. JENKINS	..	..	..	<i>Plant Breeder</i>

INTRODUCTION

This station was established in 1953 to facilitate research into rice production under the varying natural conditions found in Nigeria, with or without supplementary irrigation. It is administered as a sub-station of the Federal Department of Agricultural Research. The Station is at Badeggi, about 9 miles east of Bida. It consists of an upland area of 146 acres used for administrative, laboratory and residential purposes, and a lowland experiment area totalling 75 acres.

The experiment fields are in a part of the western flood plain of the Gbako River (known locally as the Badeggi fadama) which is served by the Badeggi Irrigation Scheme. This scheme is a development project of the Northern Region Department of Agriculture, and likewise the Edozhigi Irrigation and Flood Control Scheme, which is about 14 miles west of Bida.

The programme of research is as follows :—

- (1) The introduction, selection and breeding of local and 'exotic' strains of rice.
- (2) Investigation into cultural methods and the use of organic and inorganic fertilizers.
- (3) Study of soil responses to continuous irrigation and varying intensities of cropping.
- (4) Study of pests, diseases and control methods.

BUILDING CONSTRUCTION PROGRAMME

Due to the inadequacy of the funds originally allocated, there was no building work in the year under review.

The Senior Service staff on the station lived in temporary accommodation throughout the year. Some relief was afforded by the construction of two temporary rest houses. All the Junior Staff quarters were occupied.

THE EXPERIMENT FIELD

The Meteorological Station (No. 0906/00C) was established in January 1955, and functioned throughout the year. Figures for monthly rainfall are given below with Bida aerodrome for comparison.

				<i>Badeggi</i>	<i>Bida Aerodrome</i>
January ..	..	..	..	0.00	0.12
February ..	..	..	..	0.00	0.12
March ..	..	..	..	0.03	1.03
April ..	..	..	..	6.91	3.02
May ..	..	..	..	2.06	6.07
June ..	..	..	..	9.96	7.74
July ..	..	..	..	13.39	7.88
August ..	..	..	..	6.82	8.47
September ..	..	..	..	14.57	10.21
October ..	..	..	..	4.19	4.02
November ..	..	..	..	0.00	0.32
December ..	..	..	..	0.00	0.01
Total				58.04	49.22

The low rainfall in May allowed the cultivation of the weed growth following the high rainfall in April. Rainfall in June and July was badly distributed, over 50 per cent falling in 3 days in each month. August rainfall was evenly distributed but the rainfall in September was unevenly distributed over two-thirds fell in 4 days in the first 2 weeks. No loss of irrigation control was occasioned by rain but flooding from the Gbako occurred on August 5th-11th, September 4th-8th, and October 5th-8th.

The whole of the 75 acres was cultivated for the 1955 season. It was intended to plant the whole of the newly broken north and centre fields (comprising 50 acres), in order to assess the comparative fertility of the zones of sandy soils (Agaie Series) and of clay soils (Badeggi Series). After one day's planting on June 3rd, heavy rains precluded further drilling on the clay soils but the yields obtained indicated great differences in productivity. The drilling rate varied from 70 to 80 lb/acre (estimate), drills were spaced at 6". Establishment and development, both of the drilled material and the much greater bulk of transplanted material (12" x 12", 2-4 plants/stand) on the 50 acres was good. However, the drilled material lodged badly at harvest. All material received 1 cwt ammonium sulphate, 6 weeks after transplanting, or combined with the drilled seed. Observations and results are summarized in the table below:—

RICE YIELDS ON THE 50 ACRE FIELD, BADEGGI

<i>Variety of Rice</i>	<i>Planting Method</i>	<i>Soil Type</i>	<i>Acreage</i>	<i>Yield (cwt/acre)</i>
BG79 (<i>ex A. O. Bida</i>) ..	Drilled	Agaie Series	3.6	6.5
G79 (<i>ex A. O. Bida</i>) ..	Transplanted	Agaie Series	10.6	11.8
Ngasein 57	Drilled	Badeggi Series	3.6	20.8
Ngasein 57	Transplanted	Badeggi Series	17.4	24.3
Toma 112	Drilled	Badeggi Series	2.75	13.0
Mas 2401	Drilled	Badeggi Series	2.0	18.25

The irrigation work was to some extent exploratory, in that it was not known how far adequate experimental control of individual experiments could be achieved within the contoured layout (the whole 75 acres was contour banded at 4" vertical intervals). This year's experience has shown that, given adequate water supplies to the whole area, and save for years of abnormal flooding, a disproportionate area of land is wasted within each contour strip.

THE EXPERIMENT PROGRAMME 1955

Priority was given to preliminary investigations into the use of inorganic fertilizers and cultural practices, while the varietal collection was continuously and closely studied. Since rice is a comparatively new crop in Nigeria, it seems likely that much greater increases in production will accrue from improved methods of cultivation and economical use of fertilizer, rather than from a varietal improvement. Until more is known of the physical and chemical composition of soils of the rice areas and methods of maintaining their fertility, the dangers of rapid soil exhaustion are likely to be increased by the introduction of higher yielding varieties.

The maintenance collection contained 254 separate cultures at the end of 1955 including new introductions. These were grown, so far as possible, under uniform cultural conditions. Emphasis was placed on recording quantitative data, particularly factors affecting yield (*e.g.*, tiller number, tiller height, panicle weight and panicle length). Flowering date and grain size were also measured. Although from the point of view of recording purposes the 1955 season was abnormal, it did provide information on the flood resistance of stocks maintained in the varietal collection.

Flooding resulted in the destruction and loss of three varieties, J7 (*ex* Orisa), D.S. No. 1 (*ex* Hungary *via* Swaziland), and Farin Irin Jatua A2 (*ex* Birnin Kebbi). The floating rice Mbag Boli, from Sierra Leone and the Malayan varieties Kontor, Anak Didek and Radin China 4 were found to have excellent properties of flood resistance. Other varieties displaying an ability to recover from submergence were:—India Palil *ex* Sierra Leone, Rokupr selections Indo-China 24 and 53, Burmese varieties HM-C-17, MTU-16, and Ngasein 57, Kavunginpoonthala and PTB 16 from Madras and D 99 from British Guiana. Of the Stocks of *Oryza glaberrima* maintained in the collection, Dan Kashin Shanu A5 and Dan Mai Zudun A5 were found to have the greatest tolerance of submergence.

Some twenty-six selections and re-selections from established varieties made in 1954, were grown in ear-rows for observation. Of these, D.S. No. 1/1/55 was destroyed by flooding. Four others, two of them re-selections from Ngasein 57, one from D110 and one from No. 79, were rejected as having undesirable characters. The remaining twenty-one selections are being retained as ear-rows during the 1956 season, thereby undergoing maintenance at the same stage as the selections made during 1955.

Eight hundred and forty selections and re-selections made from 28 established varieties during the 1955 season, were later subjected to further examination in the temporary laboratory. Five of the original stocks were subsequently abandoned as being untrue to type. The final number retained for planting out as ear rows during 1956 was one hundred and thirty-eight.

Twenty-eight established varieties were grown in small multiplication blocks measuring, on the average, 0.04 acres. The purpose of these was to provide interim material for multiplication and distribution until such time as Rice Research Scheme stocks can be released. The varieties were subjected to thorough roguing and observation. Five varieties were abandoned as being off-type. These were BG79 *ex* Samaru, BG79 *ex* Adani, BG79 *ex* Obidu, GEB 24 *ex* Samaru and GEB 24 *ex* Port Harcourt. The remaining 23 varieties are to be placed in Rice Research Scheme and Regional co-ordinated inter-varietal trials in 1956, 1957 and 1958 after which seed of unpromising varieties will no longer be made available. Data of flowering dates, tiller number, tiller height, panicle length and panicle weight were recorded.

In addition, 19 selections from seven varieties from Rokupr were multiplied for varietal trials in 1956. Close observation was made for rogues and segregants. Seven out of nineteen showed definite bi-modal flowering curves indicating mixture. This will be taken up with

West African Rice Research Station, if the results are repeated in 1956 since these were imported as pure stocks each derived from single plant selections. Of those grown BG79/16, GEB24/37, D85/42, Indo-China 24, and India Palil 46 were outstanding. Lead/35 and /44 also gave good yields.

Thirteen varieties of *Oryza glaberrima* from Sokoto Province, and one from Katsina, have been added to the collection this year. They will be kept under observation to determine whether they represent new material or merely represent duplicated Hausa names. No new paddy type is evident, except one from Katsina, which has a hairy golden husk and long awns. Our preliminary classification of *O. glaberrima* grain types has been modified accordingly. The upland varieties Oshodi, Bikom and Agbede were brought from Shemankar by the Plant Breeder as well as a sample of GEB 24 from Kware.

PLANT PATHOLOGY

STAFF

S. R. Chant *Plant Pathologist*

The duties of the Plant Pathologist include work in connexion with plant introduction and quarantine. Investigational work has been mainly concerned with cassava mosaic, but other diseases studied were 'concentric ring blotch' of citrus, yam disease and cocoa seedling wilt.

CASSAVA MOSAIC

From observations made in 1954, it was found that in the variety GCH7, there were significant differences between areas of leaves of the same petiole length and age, depending on whether they were (i) symptomless (ii) displaying mosaic only (iii) displaying crinkling (with mosaic) or (iv) displaying distortion (with mosaic). Other varieties also showed similar differences in leaf area with respect to these types of symptom expression as shown in the table below :—

Comparison of the areas of leaves (petiole length 3-4 inches) of 3 varieties of cassava displaying (i) mosaic only and (ii) crinkling and distortion (with mosaic) with the mean area of symptomless leaves taken from the same infected plants.

Variety	Mean Leaf area (square metres) of 5 samples of 100 leaves		
	Symptomless	Mosaic only	Crinkle and Distortion (with mosaic)
Oloronto	7.31	6.58	4.73
Karagba	6.46	5.41	4.79
NL 5.. .. .	6.12	4.91	4.44

Statistical analysis of the results shows that, within each variety, the difference between the mean areas of the samples belonging to the various categories are all significant (at $P=0.05$, or even at $P=0.01$, in some cases.)

A field experiment was designed to assess the association between symptom expression and growth rate and yield of these three varieties, and also to observe whether applications of sulphate of ammonia affected these relationships.

Plots were sampled at 6 weekly intervals. It was found that from May till October, the variety Oloronto produced the greatest leaf area and the highest root weight. In November and December, the leaf area of Oloronto was more markedly reduced than that of either Karagba or NL5, due to the dry weather conditions causing premature abscission of the leaves. During this period, the differences between the root weights of the three varieties tended to decrease.

There was a tendency, however, throughout the duration of the experiment for Oloronto to display (a) the least amount of chlorosis on its leaves (b) the least number of leaves with distortion and crinkle and (c) the greatest number of symptomless leaves.

The application of sulphate of ammonia was associated with a significant increase in leaf area and root weight in all varieties, but it had no apparent effect on symptom expression.

It would seem possible, therefore, that the better yield of Oloronto can be attributed, in part, to its leaves being less severely affected by mosaic. If confirmation can be secured on this point, it may prove to be an additional guide in the breeding of tolerant varieties.

A satisfactory technique has been evolved to restrict the feeding of white flies (*Bemisia* spp.) to small areas of individual leaves. Although this method has been extensively employed, it has not yet been possible to isolate any distinct strains of the virus.

The virus has been successfully transmitted by patch grafting with stem tissue, but leaf grafts have so far proved unsatisfactory.

None of the chemical compounds so far tested in attempts at chemotherapy, has been associated with any diminution in symptom expression.

Cuttings which were germinated and grown for 4 weeks in a hot air chamber (35-37°C) in October 1955, still produced non-chlorotic leaves in late December, in an insect-proof greenhouse. There seems to be some possibility that prolonged heat treatment may at least partially inhibit the virus in the plant.

CONCENTRIC RING BLOTCH OF CITRUS

This disease disappeared entirely from the Moor Plantation citrus nursery, although a few affected plants are still to be found at the Western Region Production Development Board's nursery at Eleiyele, near Ibadan.

SUSPECTED VIRUS DISEASE OF YAMS

In September 1955, a survey was made of some of the yam growing areas of the Northern, Western and Eastern Regions. The disease was observed in Ondo, Oyo, Ibadan, Abeokuta and Benin Provinces in the Western Region. It seems possible that some yams in Onitsha Province, Eastern Region, also had this disease. Tubers from infected plants have been obtained from Ilorin, Northern Region, and will be used in transmission work next season.

COCOA SEEDLING WILT

As in the 1954 season, cocoa nurseries all over the Western Region have been severely affected by wilt. The period of peak incidence appears to be in the months of August, September and October, when rainfall and humidity are at relatively high levels.

Experiments carried out in association with the Western Region Cocoa Agronomist from August to October 1955, have given the following results:—

- (i) The incidence of wilt is greatly affected by the type of soil in which the seedlings are grown.
- (ii) The incidence of wilt is greater under heavy shade than under light shade conditions.
- (iii) Fungicidal spraying can control the disease. Work on the isolation of the pathogen continues.

MAIZE RUST RESEARCH SCHEME

STAFF

Dr W. R. Stanton..	..	Senior Scientific Officer
R. H. Cammack ..	..	Scientific Officer

The following is a summary of the work of the Maize Rust Research Unit during the current year. Detailed accounts are given in the Unit's Annual Report.

Breeding.—Yield Trials were carried out with a number of top cross hybrids and a selection of the inbred lines from the Caribbean areas. The trials were conducted in eight stations in West Africa, but mainly in Nigeria and in the Gold Coast. The aims were, in the case of the hybrids, to test the combining ability of the inbred lines used in the crosses, and in the case of the Caribbean inbred lines, to determine their yielding ability.

The new acquisitions from the East African Agricultural and Forestry Research Organisation, Kenya, and from Gainesville, Florida are being multiplied for further tests. Hybrids and back-crosses of West African Maize Rust Research Unit improved lines and tested inbreds from California, Italy and Minnesota have been produced. The incorporation of 'polysora' resistance into white flour lines still continues.

Seed samples in connection with the West African Seed Survey project are still being collected. During the first half of the year, four hundred such samples were grown and observed for agronomic characters. Over four hundred more samples now in the Unit's cold store will be tested early in 1956. The aims of the survey are to determine the preferences of different areas, the selection which has taken place and to study the genetic variation in indigenous maizes. The latter information will be valuable in breeding varieties of maize acceptable in the different maize-growing areas of West Africa.

Distribution of Varieties.—The varieties WAMRU 1, and WAMRU 2, continue to be sent out for multiplication and distribution both in Nigeria and the Gold Coast.

Genetics.—Studies of the inheritance of rust resistance has continued in the greenhouse. In both Mexico 13 and Mexico 16 families, rust segregation fits a 3 : 1 ratio. With the exception of 'glossy seedling' and 'iojap stripe', segregation of the Illinois marker genes at present in use fit a 3 : 1 ratio. From results obtained to date, no indication of linkage has been found between *Puccinia polysora* resistance and the marker genes used. A full report appears in the Unit's Annual Report for 1954.

Pathology.—Greenhouse testing of seedling reactions to rust have continued on all new acquisitions and derivatives. In August, rust was brought from the Gold Coast and established on seedlings of a susceptible variety. On inoculating derivatives of Mexico 13 variety with rust from Ibadan and from the Gold Coast, differential reactions were obtained. Further tests determined the existence of a new physiologic form of rust.

Leaf blight, *Helminthosporium turcicum*, is a pathogen of major importance on selected varieties. Spraying experiments with 'Nabam' gave an increase in yield of 18% over the controls. Resistant varieties have been introduced and the incorporation of resistance to blight is a major project in the breeding programme.

In studies of the epidemiology of fungal pathogens of maize, the Volumetric Spore Trap has given information on the diurnal and seasonal behaviour of several diseases, with special reference to rust and leaf blight. The results are being related to crop climate.

The system of assay plots distributed over Nigeria to investigate the incidence of *Puccinia polysora* was used to carry out a disease survey, and a list of fungi affecting maize in Nigeria has been prepared.

ENTOMOLOGY

STAFF

G. S. Cotterell	..	..	..	..	..	Senior Entomologist
J. T. Davey	..	..	..	..	..	Entomologist
J. L. Gregory	..	..	..	..	..	Entomologist
K. M. Harris	..	..	..	..	..	Entomologist
F. O. Iwenjora	..	..	..	..	..	Laboratory Superintendent

AFRICAN MIGRATORY LOCUST—J. T. DAVEY

Mr J. T. Davey has continued to be on secondment to the International African Migratory Locust Organisation, based on Kara in French Sudan. He has been studying the movements of locusts between the outbreak area and the surrounding country. As a result of successful marking experiments, during which more than half a million individuals were marked, it has been possible to trace migrations of the solitary populations in different seasons.

The original definition of the outbreak area (5th International Locust Conference) included only the plains of the Central Niger Delta which are still flooded each year, and, at that time, there was no evidence to suggest that the locusts were not confined there all the year. The results of our marking campaigns show that the original limits are arbitrary, and that seasonal migrations of individuals, and probably whole populations, take place between the inundated plains and the adjacent semi-arid regions. The average distance covered during these movements is of the order of 75 kilometres but marked locusts have been recaptured more than 300 kilometres from the site where they were marked. Our researches suggest that such migrations are part of a closed annual cycle. Locusts leave the plains for the semi-arid regions, when the former habitats become flooded in summer, and breed in the semi-arid regions throughout the rains. In the autumn, when the floods retreat and the first habitats on the plains become uncovered, there is a return movement. The initial concentration of returning adults in the first few habitats exposed in the south of the outbreak area is quickly followed by a dispersion of the population northwards as the flood waters continue to recede in the same direction. Thus, in the course of three or four months all the plains are again repopulated, the locusts breeding and remaining there until the floods rise again. When the rains begin, the annual exodus recurs; the complete cycle may include three or even four generations.

A remarkable feature of the marking campaigns, has been the 'repeatability' of the results obtained over the past three years, the same habitats being repopulated at about the same time by locusts coming from the same parts of the semi-arid regions. It is this fact which allows us to draw some tentative conclusions, especially as regards the far-reaching practical implications. By knowing the densities of populations in the semi-arid regions on both sides of the plains in the autumn, the staff of the control service can estimate both the number of locusts which are likely to appear later within the outbreak area and the probable habitats which will be colonised. It is now possible to reorganize the existing scouting system on the basis of the new conception of population dynamics. If the same routes are followed each year (and all the available evidence suggests that this is so) then it follows that only restricted areas of the plains are important. In this respect it is significant that all the hopper bands destroyed by the control service in the past ten years (with only one exception all these hopper bands developed amongst the progeny of the returning Sahelian adults between November and March) have arisen in the very habitats from which the greatest numbers of marked locusts have also been recovered. Large tracts of the flooded zone can probably be ignored except for occasional scouting at certain seasons of the year.

Finally, there is the most interesting possibility of a link between this singular cycle of seasonal migrations and the existence for *Locusta*, of a well defined outbreak area. By occupying a series of seasonal habitats, the locusts can breed continuously throughout the year and in the face of unfavourable environmental conditions. The peculiar cyclical nature of the migrations (possibly related to unique climatical factors) ensures that a certain number of locusts repopulate and breed each year in the alternate habitats. It may well be found that in other parts of Africa, where populations of the African Migratory Locust exist but where no swarms develop (e.g., the shores of Lake Chad) seasonal migrations, although occurring, are less complete and there is always a check in the breeding cycle at some season of the year.

DESERT LOCUST

This locust has been active in its swarming phase, breeding taking place according to season, between north and west Africa and the Indian sub-continent. The south-westerly movement of swarms reached French Niger Province and Tchad, breeding taking place a few miles north and east of the northern frontier of Nigeria, where control measure were instituted by the French authorities.

One immature flying swarm entered Nigeria in the extreme north of Bornu (Mobber district) in mid-July 1955, returning later to French Niger. No breeding occurred in Nigeria. By March 1956, the nearest swarms were reported from north Africa (Morocco and Algeria) where spring breeding had commenced. Later in the year, escapes of adult swarms of the next generation from this area, may invade French West African territory south of the Sahara, and possibly extend into the northern provinces of Nigeria.

TREE LOCUST

This locust is endemic in the extreme north of Nigeria and neighbouring territories. It was abnormally active in February and March, and caused some alarm, owing to its resemblance to the Desert Locust. This species is not important internationally, and damage is confined to trees of little economic importance in Nigeria. The authorities concerned have been informed that no threat to economic crops is anticipated, but "Aduwe" trees (*Balanites aegyptiaca*), known as 'desert date', were defoliated in Bauchi Province.

STUDIES ON THE BIOLOGY AND CONTROL OF BEETLES ATTACKING YAMS—J. L. GREGORY

Three experiments were laid down to compare the effect of various insecticidal dusts applied to yam setts before planting.

In the first experiment, yams treated with five insecticidal dusts were compared with untreated yams. As the layout had to conform with that of another experiment, it is possible to compare statistically the effect of only three of these insecticides, but the figures for the other two insecticides are also given.

	Treatment			0.45% Gamma B.H.C.	Signifi- cant differ- ence at 5%	26% Gamma B.H.C.	5% D.D.T.
	Control	Heptachlor 25% Wettable Powder	Chlordane 50% Wettable Powder				
Rates (lb. per acre)	—	27	34	38	—	27	18
Yield (lb. per acre)	9,400	10,200	10,900	9,800	1,500	7,900	9,600
Percentage Yams attacked	59	15	12	20	8	10	33

The whole of this trial was flooded from 10th to 13th September, 1955. This caused premature death of the yam vines and, therefore, presumably lower yields than would otherwise have been obtained.

The differences in yield between the four comparable treatments are not statistically significant, unless the other two treatments are also included in the comparison.

The difference between beetle infestations caused by the various treatments were highly significant. As in previous experiments, the crude BHC dust (2.6% gamma BHC) most efficiently controlled beetle infestation, but again reduced yield. Chlordane decreased beetle infestation almost as much, and increased yield by 15%.

The second experiment was a trial of the effect of BHC dust (0.45% gamma BHC) applied to yam setts before planting. There were four replications of the two treatments, dusted and not dusted.

Undusted plots yielded an average of 2,300 lb. per acre and dusted ones 4,100 lb. per acre, an increase of 78%. On the untreated plots, the percentage of yams attacked was 83% and on the dusted plots it was 32%.

One of the untreated plots was flooded, but this would not explain the high yield differences obtained in this experiment, because the increase in yield without this pair of plots would still be 69%.

In the third experiment, the yields of yams treated with 0.45% gamma BHC, 5% DDT and 10% DDT dusts before planting, were compared with untreated yams.

Only 32% of the yams on the control plots were attacked by yam beetle and with such a low infestation it is hardly surprising that no significant yield increases were recorded. Infestations were reduced significantly by all three insecticides but the BHC dust was distinctly superior to the two strengths of DDT dust in this respect.

CEREAL STEM BORERS (I) WESTERN REGION OF NIGERIA—J. L. GREGORY

Early Maize Experiment.—An attempt was made to determine the effect upon yield of a given borer population, by protecting maize plants from infestation by weekly applications of 5% DDT dust. There were five pairs of plots and one of each pair was treated. The dusting did not prevent some plants being attacked, but a reduction in plants attacked from 28% to 14% was obtained. There was no significant difference in yield between treated and untreated plots, bearing out previous observations that the effect caused by stem borers upon yield of early maize is usually negligible.

Late Maize Experiment.—An experiment was laid down on late maize at Moor Plantation to compare four insecticides at two different concentrations (applied either once or twice), upon the yield and borer attack of four different varieties of maize.

The insecticides used were :—

Endrin emulsifiable concentrate, diluted to 0.034 per cent and 0.017 per cent

Heptachlor wettable powder, diluted to 0.082 per cent and 0.041 per cent

Aldrin emulsifiable concentrate, diluted to 0.052 per cent and 0.016 per cent

DDT dust 10 per cent and 5 per cent

Insecticides were applied to young maize plants three weeks and five weeks after planting. The effects of varieties and of insecticides, respectively, are summarized below.

<i>Varieties</i>	<i>Mexico I</i>	<i>Trinidad Bulk</i>	<i>Lagos White</i>	<i>Sicaragua</i>	<i>Significant difference at 5 per cent</i>
Yield (lb. per acre) ..	1,150	1,030	870	1,030	10
Percentage infected joints	1.99	2.23	1.86	3.15	0.55

Mexico I gave the highest yield and suffered least stem borer attack of the imported varieties. It sustained slightly more borer damage than the variety which had least damage (Lagos White).

<i>Insecticide</i>	<i>Endrin</i>	<i>Heptachlor</i>	<i>Aldrin</i>	<i>DDT</i>	<i>No treatment</i>	<i>Significant difference at 5 per cent</i>
Yield (lb. per acre)	1,090	1,020	1,030	1,020	950	60
Percentage infected joints ..	1.88	2.24	2.18	2.52	2.9	0.61

As in previous experiments, Endrin gave the greatest increase in yield and the greatest decrease in borer infestation. DDT dust has successfully controlled cereal stem borers in the Gold Coast, but was relatively ineffective in this experiment.

A second application of insecticide had no significant effect upon yield, but decreased percentage joints attacked from 2.6 per cent to 2.1 per cent.

CEREAL STEM BORERS : (II) NORTHERN REGION OF NIGERIA—K. M. HARRIS

Laboratory rearing of larvae collected from cereal crops has resulted in the following host records :—

<i>Sesamia poephaga</i>	Guineacorn	Samaru	1 specimen
<i>Bussiola fusca</i>	Guineacorn	Samaru	5 specimens
<i>Sesamia calamistis</i>	Maize	Samaru	8 specimens
<i>Sesamia botanephaga</i>	Rice	Badeggi	2 specimens

The distribution of the main borer genera was as follows :—

Sesamia sp., dominant in sorghum at end of season in Zaria and Kano Provinces.

Busseola sp. was abundant in Zaria and Kano Provinces.

Coniesta sp. has been found in sorghum at Bida and also at Daura and Gusau, but not at intermediate places, although it is abundant in millet everywhere. There are indications that the *Agrotid* borers are reaching their limit of distribution north of Kano ; at Daura the only serious borer problem is that of *Coniesta* in millet, and occasionally in sorghum. A serious attack of *Coniesta* on sorghum was recorded from Sokoto.

One specimen of *Eldana* species has been bred from sorghum.

Sesamia and *Bussiola* have been found in maize at Samaru.

Sesamia continued to pupate and emerge throughout the dry season, but larvae of *Eldana*, *Coniesta* and *Busseola* have not pupated. Larvae of *Eldana* and *Coniesta* entered diapause during the early dry season, but *Busseola* larvae remained moderately active.

No cereal stem borer has yet been found associated with a wild alternative host.

A study of old sorghum fields at Samaru showed that there were sufficient live larvae throughout the dry season to reinfest the new crop as soon as it was planted.

In an experiment at Kano, there was a significant positive correlation between the number of stems bored and the yield, indicating that the higher the proportion of stems bored the higher the yield. A similar result had previously been obtained at Samaru. Therefore, it appears that stem borers thrive in relatively high yielding plants, under conditions not yet fully understood.

The general level of borer attack gives the impression of being high when recorded as percentage of stems bored, but the damage done to the crop does not approach the severity of that done by midge (*Contarinia*) until the borer population reaches a much higher level. However, borer damage can be severe when poor growing conditions have rendered the crop particularly susceptible to mechanical damage by the larvae.

SORGHUM MIDGE STUDIES—K. M. HARRIS

Observations began towards the end of the rainy season. No live midges were seen at Samaru after November 11th, subsequently, diapausing larvae were abundant in the seed heads. No midge had broken diapause by the end of March, although the first rains fell on February 23rd.

Sample counts, after harvest of sorghum varietal trials, have given populations varying between 54 and 84 diapausing larvae per 100 sorghum spikelets.

In fields which have been efficiently cleared of crop debris, by burning, comparatively few spikelets remain, but if these are heavily infested with diapause larvae then they may form a source of infection for the succeeding crop. Fields which have not been properly cleared of crop residues during the dry season are important sources of reinfestation.

Some parasites of sorghum midge have emerged and have been preserved for identification.

Infestation counts were made in a number of localities, mainly upon Departmental farms in November and December. About 40 per cent of the fields examined had grain losses exceeding 10 per cent of the crop, and some crops sustained as high as 40 per cent loss of grain.

At Samaru, midge damage was especially severe in the Botanist's Uniform Nursery and in the adjacent Varietal Trials. It is possible that this severity is due to the prevailing conditions. When many different varieties are grown in proximity, there may be optimum conditions for a build-up of midge population.

On two out of three trials, there was a significant negative correlation between proportion of spikelets damaged by midge and yield, indicating that, as is to be expected, attack by sorghum midge depresses yield of threshed grain. The absence of a significant result in the third trial may be due to the low general level of midge attack, or to the sampling method used.

Midge has been active at Ibadan, and specimens have been obtained from *Sorghum arundinaceum* (wild sorghum), *S. guineense* (Farafara) and from *S. caudatum* (Jaddawa). Specimens from all three hosts were mainly of the *Contarinia sorghicola* group with occasional *Lestodiplosis*.

Parasites have been recorded on two occasions. In *S. arundinaceum* and *S. guineense* collected on 12th March, 1956, a small number of diapausing larvae was found, but the conditions of rainfall and relative humidity in operation at Ibadan render diapause of far less significance than in Northern Nigeria, where it appears to be the sole means of carrying over from one growing season to the next.

STUDIES ON THE CONTROL OF THE CAPSID PESTS OF COCOA—G. S. COTTERELL

Large scale insecticide trials were instituted by Mr Gregory on mature cocoa, based on similar trials in the Gold Coast :—

(i) Spraying with a formulation based on gamma BHC at 4 oz., and at 6 oz., gamma BHC per acre in 5 gallons of water per acre, using power-operated low-volume shoulder-mounted sprayers.

(ii) Dusting with a formulation based on crude BHC and containing 0.65% gamma BHC at 2 oz., gamma BHC (20 lb. dust formulation) per acre, using power-operated high-volume shoulder-mounted dusters.

Applications were made at approximately one monthly intervals, beginning in August and ceasing in February.

Since the first spray application, no capsid damage has been observed, and the only leaf-blast seen has been due to old damage. Good control was also obtained with dust but some damage was observed. This method suffers from the drawback, under Nigerian conditions, that dust may not be retained in the canopy, owing to high temperature conditions. It is necessary to stop dusting operations after about 10 a.m. on cloudless days, whereas spraying operations can be continued throughout the day. There are indications of yield increases following capsid control, with subsequent tree regeneration.

As a result of the highly successful results obtained, particularly by spraying, large-scale demonstrations are to be carried out by the Department of Agriculture, Western Region, in 1956/57. A number of power-operated low-volume sprayers have been ordered by farmers in Ondo Province.

Figures obtained show that capsid incidence commences to rise in August. Treatment with gamma BHC (Lindane) at 4 oz. per acre commenced in August 1955 and continued at approximately one monthly intervals to February 1956. The capsid population on the treated plot dropped to 'nil' at the first spraying and remained so, whereas on the untreated plot it rose to a maximum of 150 bugs per 100 trees by mid-January. The regeneration on the contiguous untreated plot became noticeable by November.

Records from a large scale trial at Akola (near Ilesha) have been continued, treatments were application of 5% DDT at 20 lb. per acre in August, and subsequently when capsid population exceeded 40 per 100 trees. This figure was only exceeded once during the year necessitating additional treatment.

Observations on a plot at Ajoue indicate that once capsids have been controlled the effect may last for some years.

An experiment has been laid down at Owena to compare the economics of regeneration of mature cocoa by spraying and by coppicing, and to ascertain at which stage of damage it is better to coppice or to spray. No definite conclusions can yet be drawn and the experiment is continuing.

Complete control of capsids in mature cocoa has been obtained by monthly low-volume spray applications from August to February at 6 oz. gamma BHC per acre at monthly intervals.

WHITEFLY VECTORS OF CASSAVA MOSAIC—G. S. COTTERELL.

Studies to date have consisted mainly of a survey of host plants of *Aleyrodidae* in the Ibadan area, particularly of *Bemisia* species, which are vectors of cassava mosaic, cotton and tobacco leaf curl.

A number of host plants of *Bemisia* have been found in the Ibadan area, both wild and cultivated, covering a wide range of botanical orders. The survey is being continued by Dr Eastop, British Museum (Natural History), who is extending the survey to include other climatic zones of Nigeria.

The validity of recorded species of *Bemisia* is in doubt and it is possible that most of those so far recorded will be found to be *B. tabaci*. Studies have been commenced to ascertain:—

(i) whether small differences observed in Nigeria are of specific value or merely nutritional in effect, and

(ii) in the absence of recognised specific characters, whether there is any varietal difference associated with plant hosts of the same botanical affinity, limiting the extent of their range, and as virus vectors.

OTHER CROP PESTS

The following insect pests have been recorded:—

Cashew.—considerable loss of crop was reported from the Eastern Region, due to *Selenothrips rubrocinctus*, the red-banded cocoa thrips, which attacked the foliage, and to *Helopeltis* which attacked the shoots.

Rice.—the stem borer, *Sesamia botanophaga* was recorded on *Oryza glaberrima* and *O. sativa* at Badeggi, Northern Region (by Mr Harris). Control has been obtained by removal of stubble after harvest, and by flooding.

Yam.—some damage to young vines was caused by larvae of the leaf-eating beetle (*Crioceris* sp.) on Moor Plantation, control was obtained by spraying with DDT (one application). A more economic method would be destroying by hand.

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